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Childhood Obesity, a Public Health Crisis: Narrative Review of Public Health Interventions for Childhood Obesity

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Abstract

Introduction: Child obesity is the major pediatric public health crisis of the current century and its trend is increasing in the developing countries due to nutrition and epidemiologic transition. Considering the burden of childhood obesity and its associated outcomes need for obesity prevention in children has become priority both for government and researchers.

Objective: The objective of this review is to provide the updated knowledge and evidence from various research studies, designed to provide interventions either in school or at home.

Methodology: Electronic databases like Google scholar, PubMed and Sciencedirect were used as search engines. Key terms used during the review were obesity, overweight, childhood obesity, interventions for childhood obesity and Body Mass Index. Those intervention studies were selected which have been delivered to the 6-12 years old children either at home or at school or both.

Findings: Schools are essential social environment for children and many endeavors have been made to utilize this environment to uphold healthy behaviors among youth, including healthful eating habit. Furthermore, greater involvement of family members has been suggested as a way of increasing the effectiveness of interventions aimed at weight control, weight maintenance, and weight loss.

Conclusion: School curriculum including healthy eating, physical activity, development of movement skills, improvements in nutritional quality of the food supply in schools, environments, and cultural practices can play a vital role in preventing the obesity. Moreover, weight-loss interventions targeting food intake and/or physical activity might be most operative if they involve family members appropriately. Involving parents in the home setting to encourage children to be more active, eat more nutritious foods and spend less time in screen-based activities can prevent the childhood obesity.

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Background

Child obesity is the major pediatric public health concern, affecting 155 million school going children and young generation [1] and is more prevalent among countries experiencing economic and nutrition transition [2]. Childhood obesity is more common in high-income countries with 20% to 30% higher prevalence in Europe and America compared to sub-Saharan Africa and Asia [3,4]. Ten percent of school-age children around the world are likely to carry extra body fat and of this one-quarter are obese [5]. There has been a major shift in the primary causes of obesity over

the period of last 20 years. In the 1980s, Barker and his colleagues identified birth weight as a key predictor of adult chronic diseases and they developed the Fetal Origins of Adult Disease (FOAD) hypothesis [6]. Childhood obesity is multifactorial in nature [7,8], comprising a series of interactions among genetic and learned behavior (host), energy imbalance (agent) and profuse food intake, inactive lifestyle and economic and socio-cultural stimuli (potential environment) [8,9]. Through this interaction obesity may lead to multiple consequences like cardiovascular diseases, hypertension, cancer and psychosocial consequences in the adult life [10]. Moreover, the rising trends in excess weight

among children and its consequences among adolescents will put a heavy burden on society and health system [11]. Considering the burden of childhood obesity and its associated outcomes, the need for obesity prevention in children has become priority both for government and researchers [2]. Although, prevention or treatment of childhood obesity is challenging due to multifactorial nature of childhood obesity, but different government policies and initiatives are trying to address the childhood obesity across the world through different ways [2].

There is evidence that appropriate time to target the obesity prevention interventions is the early years of an individual [12]. Given the high costs of obesity and comorbidities in terms of health-care expenditure and quality of life, prevention strategies are paramount, particularly in low-income and middle-income countries that must manage to coexist infectious diseases and undernutrition in addition to the obesity epidemic [2]. Management of childhood obesity can be done through pharmacological and non-pharmacological methods [13]. Pharmacological options vary from medicines to surgical treatment. On the other hand, non-pharmacological management includes modification of behavioral factors like increasing physical activity and reducing intake of unhealthy diet and modifying the shared environment [13]. Non-pharmacological management comprises of a comprehensive and holistic approach including the individual, family and school interventions [13]. Most evidence reviews, to date, have focused on individual behavior change rather than the 'obesogenic environment', defined as 'the sum of the influences that the surroundings, opportunities or conditions of life have on promoting obesity in individuals and populations [14]. Children interact with the environment in multiple micro- (local) environments or settings, including schools, homes, and neighborhoods [14,15]. These are, in turn, influenced by the broader macro environments (such as the education and health systems, government, the food industry and a society's attitudes and beliefs), which are less amenable to the control of individuals. Modifying the 'obesogenic' environment could produce a more lasting effect on behavioral change [15]. Furthermore, parents or caregivers have an important and long-lasting impact on child's lifestyle and parents act as an important mediator to change the behavior of children [14]. Similarly, schools provide a platform for health education and health promotion to adopt healthy behavior and healthy lifestyle throughout the critical period of child's growth and development [14]. Hence, family and school-based interventions are being given more importance to manage childhood obesity than individual based interventions [14]. Multiple families and school base interventions have been designed across the world and efficacy of those interventions has also been tested [16]. Thus, it is important to review these interventions in order to manage the rising epidemic of childhood obesity in a timely manner to avoid the long-term consequences of childhood obesity. Hence, the aim of this narrative review is to provide the updated knowledge and evidence from various research studies, designed to provide interventions either in school or at home.

Methods

Search strategies and data sources

Key terms used during the review were obesity, overweight, childhood obesity, interventions for childhood obesity and Body Mass Index. Electronic databases like Google scholar; Pub med and Science direct were used as search engines.

Electronic searching was carried out for the papers, which were published in last ten years in developing countries. All those studies were included whose study designs were randomized controlled trials and got published in The English language. Those intervention studies were selected which have been delivered to the 6-12 years old children either at home or at school or both. Thus, interventions were broadly classified into school-based and family-based interventions.

Complete papers were reviewed and included rather than the abstracts only. Hence, we tried to review around 35 articles regarding school-based interventions for obesity prevention and control and around 10 articles were reviewed regarding family-based interventions. Out of these 45 studies, findings are mentioned for those studies which showed a significant reduction in weight gain or BMI among children (significant positive findings). All the studies of negative findings have not been synthesized in this review.

Results

School/childcare settings (school-based interventions)

Schools are essential social environment for children and many endeavors have been made to utilize this environment to uphold healthy behaviors among youth, including healthful eating habit [17,18]. Other prompting features at school for eating behaviors are food and drinks available at a school outside meals and nutrition education classes. Schools, therefore, represent a central location to encourage and deliver healthy nutrition and nutrition education [19].

Findings of Studies

Trost et al. [20] conducted a randomized control trial with the aim to increase preschool children's physical activity at a distinct childcare center with four classes of kids attending a comprehensive half-day preschool program for 2 hours on each of 4 days/week. Classes were randomized to intervention (n=20) or control group (n=22). Children in intervention groups received an 8 week "Move and Learn" program including integration of physical activity into all parts of the curriculum. Teachers and staff in the intervention group attended a 3 h training meeting and watched a video on "Move and Learn" activities. Physical activity was checked by accelerometers and 15 min of direct observation during preschool sessions 2 days per week. Higher levels of moderate to vigorous physical activity were found in the intervention group as compared to control group.

Kain et al. [21] designed a cluster case-controlled trial in Chile in 2004. The intervention was designed with the aim to change

adiposity and physical activity levels of the children. The total intervention period was for about six months and intervention was provided by a nutritionist and a physical education teacher. Sessions covered 90 min additional physical activity weekly for 6 months and 15 minutes of activity in the break every day for last 3 months. After six months, it was found that shuttle run test and lower back flexibility was improved in the children of the intervention group and there was a significant change in the BMI of the participants in the intervention group as compared to control group. Standardized mean change in Body Mass Index (BMI/zBMI) from baseline to post-intervention was -0.19 with 95% CI -0.30, -0.09.

Another study was conducted by James et al. [22] in the Southern United Kingdom in 2004 for one year. The intervention was delivered by the author and his current staff. This was aimed to prevent obesity by reducing ingestion of carbonated drinks. Three sessions, one per term, were delivered to encourage drinking water and to decrease the intake of carbonated drinks. Standardized mean change in Body Mass Index (BMI/zBMI) from baseline to post-intervention was -0.39 with 95% CI -0.56, -0.23. Children in intervention classes reported fewer carbonated drinks, 6 glasses fewer as compared to controls. At 1 year, the mean percentage of overweight and obese children increased in the control clusters by 7.5%, compared with a decrease in the intervention group of 0.2%.

Spiegel and Foulk [23], conducted a similar kind of study in 2006. In his study, the author gave intervention to around 534 participants against 479 controls. The intervention was based on the participation of teachers in workshops & they also received program materials. Students were orientated to the program and activities through video and print resources. Intervention classes followed a 10 min aerobic exercise daily each day during class time. The video provided a common baseline exercise routine for all intervention classes. The program activities were organized into seven discrete modules, through which students learned about their health, their attitudes and behaviors. They also learned how to incorporate physical activity into their daily life and how to improve nutrition and diet. There were significant changes in BMI, with a 2% reduction in the intervention group. Moreover, post intervention; there was an increase in fruits and vegetable consumption and physical activity levels. Intervention students reported an average of 102.5 min/week of physical activity during the school day (up from 59 min/week at baseline) and a mean level of 37.42 min/day outside of the school day (up from 22.34 min/day at baseline).

Similarly, Harrison et al. [24] designed a controlled clinical trial in 2006, whose intervention period was about 16 weeks. He randomized minimum 182 participants in the intervention group and 130 participants in the control group. Interventions consisted of 10 (30 min) teacher-led lessons on how children may spend their leisure time and realistic alternatives to TV viewing & computer games usage. Moreover, teacher resources, pupil workbooks, and diaries were provided and parents were also encouraged in writing the daily activities of their children. Physical activity self-efficacy was significantly higher in the intervention group as compared to control group.

Another cluster randomized controlled trial was conducted in 2007 by Lazaar et al. [25] in France for the period of 6 months. He divided his intervention and control groups into obese (BMI>97th percentile) and non-obese children. Two 1 h sessions each week, were held within the school timetable for the intervention group. Various combinations of 5 min exercises included exercises on coordination, exercises devoted to posture and balance, relaxation techniques, rhythm and music, exercises devoted to creative movement, games relating to group participation were taught to children. An exercise program designed to enhance the joy of movement, body awareness and team spirit. Larger proportion of obese children (BMI>97th percentile) became overweight (90th<BMI<97th percentile) in the intervention group compared with control (16.3%, P<0.05 versus 9.3%, P<0.05). The proportion of non-obese children becoming obese or overweight was greater in controls than in the intervention group (14.8%, P<0.05 versus 2.6%).

In 2008, Sanigorski et al. [26] conducted a controlled a clinical trial in Colac, Australia and randomized 1001 and 1183 children to intervention and control group respectively. Interventions were based on diet and physical activity, including school-appointed dietitian for support, implementation of school nutrition policies and training for canteen staff for canteen menu changes and lunch pack. There was professional development for teachers about healthy eating curriculum as well as class sessions conducted by dietitians and healthy lunchbox tip sheets. Physical activity strategies included, "After-school activities program", "Be Active Arts program", "Walking school buses", "Walk to school days" and promotional materials. Children in intervention population gained less weight than in the comparison population (-0.92 kg [-1.74 to -0.11], P=0.03). Children in intervention population showed lower increases in waist circumference than in the comparison population (-3.14 cm [-5.07 to -1.22], P=0.01). Children in intervention population showed lower increases in BMI z score than in the comparison population (-0.11 [-0.21 to -0.01], P=0.04).

Taylor et al. [27] designed a controlled clinical trial in 2008 and provided intervention for 2 years to around 302 participants against 270 controls. In the first year of the project, a community activity coordinator was hired at each school in the intervention area for 20 h per week to increase non-curricular activity at the break, lunchtime, and after school (provided 8 h of activity programming in the school). Resources facilitating short spurts of activity in class were established and sports equipment were made available to encourage free play. In the second year of the project, intervention initiatives were nutrition-based, and included the provision of cooled water filters in each school, science lessons highlighting the adverse health effects of sugary drinks, a community-based healthy eating resource, and the provision of free fruit for 6 months. At follow-up, mean BMI z score (and 95% CI) remained significantly lower in intervention children in the whole group (-0.17; -0.25 to -0.08) and in the group who underwent at least 1 (n=389; -0.19; -0.24 to -0.13) or 2 (n=256; -0.21; -0.29 to -0.14) full years of intervention. Intervention children were less likely to be overweight, but only in those who were present for the full intervention (RR: 0.81; 95% CI: 0.69, 0.94).

At the Family Level (Home-Based Interventions)

Greater involvement of family members has been suggested as a way of increasing the effectiveness of interventions aimed at weight control, weight maintenance and weight loss [28]. Moreover, involving family members in weight control and providing social support, where family members are conscious of appropriate behaviors to maintain, may help to achieve long-term goals for preventing obesity and associated complications [29].

Saakslahti et al. [30] aimed to affect 4 to 6-year-old children's physical activity through a 3-year family-based intervention. Families involved in a larger study were randomly selected to participate in this study. The control group (n=112) received no information, while in the intervention group, parents (n=116) attended three annual rigorous educational meetings with researchers. Meetings dealt with the importance of sensory integration (thought to occur through children's involvement in physical activity), relations between physical activities, cognitive development and academic achievement, and how and where to find physical activities and venues that children might enjoy. Parents were also provided with printed education materials twice yearly and review articles. In the second year of the intervention, parents were asked to listen to a radio program entitled "The importance of being physically active". Intervention group children attended three annual physical activity demonstration sessions lasting 45 min to 60 min. Children's physical activity was assessed using diaries completed by the parents twice yearly over the 3 years. The intervention group spent less time playing indoors ($P=0.05$) and more time playing outdoors ($P=0.04$) than the control group. Further, intervention but not control group children spent more time in "high-activity play" (e.g., running, jumping, and another physical exercise) as they grew older ($P<0.001$).

Another study conducted by Harvey-Berino and Rourke [31] in 2003 and around 20 participants was randomized to intervention and 20 were randomized to control group. The intervention was provided in homes by a local peer educator. Mothers and their children (mother-child pair) were randomly assigned to obesity prevention plus parenting support (OPPS) intervention or parenting support (PS) alone. The intervention was an adaptation of the Active Parenting Curriculum; where 11 parenting topics were covered in 16 weeks. The focus for the treatment group was exclusively on how to improve parenting skills to develop appropriate eating and exercise behaviors to prevent obesity. Children in the OPPS condition also significantly decreased energy intake ($-316 \text{ kcal/d} \pm 835 \text{ kcal/d}$ vs. $197 \text{ kcal/d} \pm 608 \text{ kcal/d}$; $p=0.05$). Thus, it was found that a home-visiting program focused on altering lifestyle behaviors and improving parenting skills showed promise for obesity prevention in high-risk Native-American children. Standardized mean change in Body Mass Index (BMI/zBMI) from baseline to post-intervention was -0.91 with 95% CI $-1.59, -0.23$.

Keller et al. [32] designed a randomized controlled trial in 2009, in which 59 participants were randomized to intervention and 185 participants were randomized to control group. The intervention period was about 12 months, during which the pediatrician carried out a low threshold intervention which consisted of an age-adapted nutrition and exercise program to encourage the awareness of the suitable diet and physical activity. Three-monthly measurement of height and weight was done by pediatrician and

standardized mean change in Body Mass Index (BMI/zBMI) from baseline to post-intervention was -1.13 with 95% CI $-1.47, -0.78$. Keller et al. [32] also reported significantly lower energy intake and percentage protein intake in the intervention group post-intervention.

Discussion

This integrative review synthesizes and analytically reviewed the methodology and findings from several randomized controlled trials, all of which were meant to answer the same research question: what are the different, effective school-based or home-based interventions for preventing and controlling childhood obesity? Although the studies have been conducted in different settings with different backgrounds and sample sizes, therefore there might be an element of heterogeneity, but it was certain that there are some intervention components in the school or home setting that have shown a significant reduction in the weight of children. These included diet or physical activity or both types of interventions, either in school or at home.

By reviewing the literature, it was observed that majority of the interventions have been delivered in school as compared to home. Moreover, long-term interventions were found to be more effective as compared to short-term interventions. Studies with combined diet and physical activity interventions were long-term (at least 1 year) and comprised of larger sample sizes as opposed to diet only or physical activity only studies.

Limitations

Limitations of some of the studies were smaller sample size and short follow-up of the study. The interventions which included behavioral modifications should have been done for a longer period of time to assess their true impact on the obesity. Moreover, limitation of the current review is that the search strategy recognized very few articles. Studies of other school and home-based interventions presented in other settings, including conferences trade journals and committee meetings, might have been overlooked. Moreover, findings of only those studies have been summarized in this review, which had significant positive impact on obesity, because for the policy making the purpose, at least those interventions need to be focused which have some impact on reducing obesity. The inclusion of positive studies might have introduced publication bias in the review.

Strengths

Despite few limitations, participants in some of the studies had been followed for more than a year and few authors had taken enough sample size to assess the effect of intervention. Moreover, all studies included in this review were randomized controlled trials which had taken care of all potential confounders and close follow-up of the children was done to assess the effect of the intervention on obesity.

Conclusion

Strong evidence was found from all the studies, to support valuable effects of child obesity prevention programs on BMI,

mainly for children aged 6 to 12 years. Different interventions have played their roles in reducing the weight or BMI of children. It is concluded that school curriculum including healthy eating, physical activity, development of movement skills, improvements in nutritional quality of the food supply in schools, environments, and cultural practices that support children and teachers and other staff to implement health promotion strategies and

activities can play a vital role in preventing the obesity in short term and other associated complication in long-term. Moreover, weight-loss interventions targeting food intake and/or physical activity might be most operative if they involve family members appropriately. Involving parents in the home setting to encourage children to be more active, eat more nutritious foods and spend less time in screen-based activities can prevent the obesity among children.

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